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### Deposited in DRO:

07 December 2012

### Version of attached file:

Published Version

### Peer-review status of attached file:

Not peer-reviewed

### Citation for published item:

Huysentruyt, Marieke and Read, Daniel (2008) 'How do people value extended warranties ? evidence from two field surveys.', Working Paper. Durham University, Durham.

### Further information on publisher's website:

<http://www.dur.ac.uk/business/faculty/working-papers/>

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**WP: 113**

**ISSN: 1741-3641 (ONLINE)**

**HOW DO PEOPLE VALUE EXTENDED WARRANTIES? :  
EVIDENCE FROM TWO FIELD SURVEYS**

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JUNE 2008

**ABSTRACT**

Extended warranties are popular but expensive. This paper examines how consumers value these warranties, and asks whether economic considerations alone can account for their popularity. Results from two field surveys show that consumers greatly overestimate both the likelihood and the cost of product breakdown. However, these biases alone do not explain their willingness to buy them. In fact, we find evidence of probability neglect, in which warranty purchase decision depends on the magnitude of the possible consequences of not having insurance and not on the probability of having to suffer these consequences. The expected emotional benefits (“peace of mind”) from having a warranty was the best predictor of purchase decision and willingness to pay. We also found that people with higher numeracy and cognitive skills are less likely to overestimate the economic determinants of warranty value, yet are still highly influenced by emotional considerations when deciding whether to purchase a warranty. We conclude by arguing that consumer welfare could be improved by increasing the competitive intensity in the market for warranties.

**1. INTRODUCTION**

Most consumer durables come with a manufacturer’s 12-month warranty that covers the costs of repairs and replacement during that period. Extended warranties extend this coverage for

an extra charge. These warranties are highly profitable,<sup>1</sup> suggesting that the consumer pays more than the financial benefits they will receive, and yet an estimated 20 to 40 percent of people who purchase consumer durables also buy a warranty. Why are people willing to pay seemingly outlandish prices to insure themselves against the risk of small losses that could usually be paid for with the money saved from not buying warranties? Are people being conned into buying warranties, or do they get non-monetary benefits that justify their cost? These questions, and others like them, are of great interest to firms, regulators and consumer advocates all over the world (e.g., Competition Commission, 2003 and 2005; Camerer et al., 2003). Despite this, we know surprisingly little about how people really value extended warranties.

The literature identifies two major influences on the warranty purchase decision. The first is how consumers perceive the risks of being uninsured or, equivalently, the benefits from being insured. It is often claimed that people buy overpriced insurance, including extended warranties, because they either overestimate or overweight the probability of having to collect on it (e.g., Kahneman and Tversky, 1979; Johnson et al., 1993; Rabin and Thaler, 2001). A second frequently cited influence, however, is the emotional benefit and especially *peace of mind* that warranties bring (Baron, Hershey and Kunreuther, 2000; Loewenstein and Lerner, 2003; Hsee and Kunreuther, 1995). Indeed, opinion polls show that peace of mind is one of the most common reasons cited for buying insurance of any kind (National Opinion Poll, 2002 and 2004; Competition Commission, 2003), and sellers of extended warranties typically focus on this as their headline selling point.<sup>2</sup> While both influences seem equally plausible, it

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<sup>1</sup> Insurance against small cost consumer durables is among the most profitable items sold by commercial electronics stores. In the US, 40 to 80 percent of the profit on electronics comes from the sale of these warranties (Consumer Reports, 2005). It is often suggested that it is only by selling warranties that commercial electronics stores can stay in business (e.g., Berner, 2004; Malester, 2004).

<sup>2</sup> We have never seen a brochure advertising extended warranties that has not mentioned “peace of mind.” To investigate this, we conducted a Google search of all sites in the .com domain containing the terms “extended warranty” and “peace of mind” and obtained 115,000 hits – with almost all items in top pages being companies selling warranties. A corresponding search replacing “peace of mind” with “probability” yielded 12,200 hits – with almost all the top items containing anti-warranty consumer advice.

remains largely unknown which is their relative importance in consumers' warranty valuation and purchase decisions.

The current paper, therefore, systematically investigates the value consumers place on extended warranties using simple, intuitive survey techniques. We conducted two sizeable field surveys and gathered two direct measures of the value consumers placed on a warranty. First, the *fair price* (what they thought it was reasonable for a retailer to charge) and *maximum willingness to pay*. In addition, we elicited subjective breakdown probabilities, anticipated costs of repair given the breakdown and perceived emotional benefits from having an extended warranty (i.e., indirect measures of warranty value), all with respect to a single consumer durable (a washing machine). The overall pattern or ranking of warranty value was consistent across the two studies, and the percentage of people willing to buy at the existing market price was close to the proportion that actually does make such purchases. In Study 1 we obtained preliminary evidence, which led to several hypotheses that were tested and validated in Study 2.

Empirical findings gained from an examination of close to 300 individuals' decisions provide three important insights into consumer warranty valuation. First, people widely overestimate both the probability of breakdown and cost of repairs, which leads their subjective actuarial value to exceed objective actuarial value roughly at a ratio of 3:1. But, contrary to widespread belief, these biases alone do not offer a sufficient (or even a necessary) explanation for why people are willing to buy a warranty. In fact, consumer estimates of fair price and maximum price are much higher than their already inflated subjective actuarial value. By contrast, these direct measures of warranty value bear a closer relationship to the *emotional benefits* anticipated from owning a warranty, as measured via a composite index of Likert-scale items. The people who indicate a higher appreciation of emotional benefits are willing to pay significantly more for the warranty, and also to buy one at their fair price. Interestingly, and also consistent with much recent research, people with greater numeracy and cognitive skills

are less likely to overestimate the size and probability of the breakdown risks, and more likely to indicate a maximum price that closely approximates perceived actuarial value. Still, they are no less influenced by emotional considerations when deciding whether to purchase the warranty.

The rest of this paper is organized as follows. The next section describes our first field survey, which we conducted in Brussels. Section 3 presents the results of our second study, which we conducted in London and Antwerp. Section 4 discusses the empirical findings in further detail. Section 5 concludes.

## **2. STUDY 1: STAMP CONTROL OFFICE**

Study 1 was conducted with a group of unemployed residents of Belgium who were visiting the stamp control office to get their dole card stamped, a monthly routine which was at the time compulsory by law. We approached potential participants when they were queuing to get their stamp and asked for their help. We stressed that the survey was strictly a research initiative with no commercial interests. Those interested in participating were directed to a research assistant and a member of ‘Plus-tôt te laat,’ an artists’ collective that had had its base in the stamp control office since 1993, who explained the particulars of the task. Participants received a hot drink and a chocolate bar while they completed the survey.

### *A. The task*

The survey was available in both French and Flemish versions. It began with a hypothetical choice between four washing machines, which differed in price (ranging from 242 Euros to 576 Euros) and attributes (such as the number of washing programmes, estimated annual water and energy consumption, and extra washing options). Figure 1 shows how the

description was given in the survey. We chose washing machines because they are a prototypical consumer durable familiar to everyone, and because they are the domestic electric appliances for which consumers most often buy extended warranties (Competition Commission, 2003).

FIGURE 1



Respondents first stated the perceived fair price for four extended warranties, covering the washing machine from one through four years. They then indicated (i) whether they would buy each warranty at its fair price, and (ii) “Supposing the four types of warranties were on offer at their (respective) fair price levels, which one, if any, would [they] choose?”

Respondents next estimated repair costs and breakdown probabilities. Repair costs were elicited by asking: “In the event that the new washing machine breaks down and is not insured, approximately how much do you expect to pay on repair bills?” Breakdown probabilities were elicited by asking for estimates of the probability that the chosen washing machine would break down. Firstly, “Out of a 100 washing machines identical to the one you chose, on average how many do you expect will *not* have broken down after 5 years of usage?” This was followed by questions that elicited perceived breakdown risks for five consecutive one-year intervals starting from the moment of purchase: “On average, out of a 100 washing machines identical to the one you chose, how many do you expect will break down at some point during the first [second][third][fourth][fifth] year after purchase?” From

these data we computed the *subjective actuarial value* of the insurance, by multiplying the expected number of breakdowns by the expected repair cost.

Respondents next provided the perceived emotional benefits from insurance by expressing their agreement, on a 7-point Likert scale, to the statements “I buy insurance because it gives me peace of mind,” “I buy insurance because it gives me comfort,” and “I buy insurance because I try to avoid unexpected costs.” The first two statements capture predictions about how one will feel having purchased the insurance, including peace of mind (Loewenstein and Lerner, 2003), and the third captures the idea that buying insurance is a way of reducing uncertainty and its associated anxiety (Caplin and Healy, 2001). The average response to these three questions constituted our first Emotional Benefits Index ( $EBI_1$  – in Study 2 we developed this index further).

Participants next attempted a test of numeracy and quantitative skills (NQS) comprised of the following four questions:

- (1) What is 15% of 1000?
- (2) Which one of the following percentages represents the largest discount on a purchase: 1%, 10%, 5%?
- (3) A TV and radio together cost €110. The TV costs a €100 more than the radio. How much does the radio cost?
- (4) It takes 5 people 5 months to save a total of € 5,000, how many months would it take 100 people to save a total of €100,000?

Questions 1 and 2 are simple tests of financial numeracy, related to those of Peters et al. (2006), while Questions 3 and 4 are modifications of two questions from Frederick’s (2005) Cognitive Reflection Task. Our NQS variable is the number of correct answers to these questions. Although it has become increasingly clear that the quality of judgment and decision-making, especially in financial domains, is predicted by performance on tasks like these (e.g., Fang et al., 2007; Frederick, 2005; Lusardi and Mitchell, 2007a and 2007b;

Lusardi, 2008; Peters et al., 2006), this has not previously been shown for decision making about insurance.

## *B. Results*

### *Overview*

Subjective actuarial values were very high (roughly three times greater than corresponding objective actuarial values), but fair prices were even higher (33% higher than subjective actuarial values). Despite this inflation, almost two-thirds of respondents specified they would buy the 3-year warranty at what they thought was a fair price. Moreover, this was not because only those who gave a low fair price were willing to buy. In fact, fair price and willingness to buy displayed only a weak relationship.— although the median fair price of those who said they would buy the warranty was lower than that of those who said they would not, the difference was small and not statistically significant.

Not everyone was willing to buy a warranty at their stated fair price. The emotional benefits index was a strong predictor of whether they would. Overall, these findings support the view that people buy extended warranties not just (or even, not at all) because they have distorted perceptions of the size or probability of breakdown risks, but also because having a warranty brings emotional gains.

Finally, those who performed better on the numeracy and quantitative skills test also behaved more like “theoretical” consumers of insurance by providing subjective actuarial values and fair prices that were lower and more closely related to objective actuarial value.

### *Price and value estimates*

According to *Consumer Reports* (2005), the probability that a washing machine will break down during the second and third year after purchase is 12%. Compared to this, the



equivalent median estimated breakdown probability in our sample was 33%. Repair costs were similarly overestimated. While in Belgium the average cost to repair a washing machine is roughly £60 (Vandenborre, 2007), the median estimated repair cost in our sample was £67 (Mean = £89.78). When combined, the two overestimates yielded an average subjective actuarial value that was approximately three times its objective actuarial value counterpart.<sup>3</sup>

And yet, although subjective actuarial values were already far too high, fair price estimates were even higher. This is shown in Table 1, which reports both the median subjective actuarial value and fair price for a 3-year warranty and for the average warranty, broken down by the type of washing machine chosen. The fair price estimates were much higher than the subjective actuarial value, irrespective of the type of washing machine chosen.

TABLE 1  
COMPARISON BETWEEN MEDIAN ACTUARIAL VALUE AND MEDIAN FAIR PRICE

<i>Machine Price</i>	3-year Warranty		Average Warranty	
	Subjective Actuarial Value (1)	Fair Price (2)	Subjective Actuarial Value (3)	Fair Price (4)
£ 162.14 N = 33	23	34	35	42
£ 210.38 N = 19	12	34	20	36
£ 300.16 N = 7	47	67	61	75
£ 385.92 N = 20	18	34	22	36
<b><i>Overall</i></b> <b><i>N = 79</i></b>	<b><i>21</i></b>	<b><i>35</i></b>	<b><i>21</i></b>	<b><i>37</i></b>

*Note:* The *average warranty* valuations (in columns (3) and (4)) relate to the average of the value estimates for one, two, three and four years of extended coverage.

We next investigated what predicts fair price. We estimated an OLS model with fair price regressed onto breakdown probability, estimated repair cost, the price of the washing machine, the emotional benefits index (EBI<sub>1</sub>), and numeracy and quantitative skills (NQS).

We also included individual characteristics such as age and sex. Table 2 presents the results of

<sup>3</sup> The median subjective actuarial value for a 3-year warranty was £21 although the objective actuarial value is approximately £7. The actual price of a 3-year warranty in Belgium, however, is about £40 – eight times as high as the (objective) actuarial value.

separate regressions employing the 3-year warranty and the average warranty as dependent variables. These analyses reveal that the main predictors of fair price were repair cost and NQS (the higher the NQS, the lower the fair price).<sup>4, 5</sup> Surprisingly, we found no significant positive relationship between fair price and expected breakdown probability – indeed, the direction of the (non-significant) relationship was actually *negative*. Although respondents greatly overestimated breakdown probability, this did not appear to be their reason for overpricing the warranty.

TABLE 2  
DETERMINANTS OF FAIR PRICE VALUE

	Fair Price for a 3-Year Warranty		Average Fair Price	
<i>Independent Variables</i>	(1)	(2)	(5)	(6)
Repair Cost	0.209 [0.09]**	0.192 [0.091]**	0.216 [0.103]**	0.194 [0.104]*
Sum of Breakdown Probability in 2 <sup>nd</sup> and 3 <sup>rd</sup> year after Product Purchase	-6.153 [14.878]	-4.861 [15.631]		
Overall Average Breakdown Probability			-3.533 [1.149]	-0.249 [1.195]
EBI <sub>i</sub>	-0.959 [3.032]	-0.715 [3.064]	0.121 [3.677]	0.601 [3.65]
NQS	-7.443 [3.648]**	-7.43 [4.1]*	-9.8 [4.622]**	-8.273 [4.921]*
Price of the Washing Machine	-0.029 [0.044]	-0.05 [0.047]	-0.017 [0.056]	-0.047 [0.063]
Age		-0.573 [0.517]		-0.814 [0.655]

<sup>4</sup> Our finding that the average expected cost of repair, and not the expected probability of breakdown, significantly correlates with the average fair price estimate is consistent with studies elsewhere. Huber, Wider and Huber (1997) found that when choosing a product, respondents were not particularly interested in precise probabilities if they were not directly supplied. Williamson, Ranyard and Cuthbert (2000) found that when deciding whether to buy an extended warranty and invited to ask for information, respondents mainly asked about the cost and the terms and conditions of the policies, again not about the probabilities of breakdown.

<sup>5</sup> Interestingly, NQS is not simply picking up the effect of schooling. When we include the level of schooling as an explanatory variable in all the regressions that we report in the paper, the coefficient of NQS barely changes (significance levels never change) and the variable schooling itself (which is a categorical variable) is never statistically significant.

Sex		7.278 [9.21]		7.765 [11.805]
Constant	48.419 [21.55]***	64.381 [20.439]***	53.84 [24.4451]**	77.24 [26.684]***
Number of Observations	75	75	72	72
R-squared	0.14	0.16	0.12	0.14

*Notes:* Robust standard errors are reported in brackets. *Average fair price* is the average of stated fair price for one year, two years, three and four years of extended warranty coverage. The data are for all survey participants. Deviations from this are accounted for by missing data.

\* Significant at the 10-percent level; \*\* Significant at the 5-percent level;

\*\*\* Significant at the 1-percent level.

### *Willingness to buy a warranty*

We also considered the market implications by asking first how many respondents would buy the extended warranty at the price they judged fair,<sup>6</sup> and then how many would buy it at the going rate. The answer to the first question is that two-thirds indicated they would buy the standard 3-year warranty at its fair price. To answer the second question we determined how many who gave a fair price equal to or greater than the standard market price indicated they would buy a warranty at that price. In Belgium, the market price of a 3-year warranty for an average washing machine is roughly £40, and 22% of our respondents indicated they would pay this much or more. This is in line with sparse data on actual warranty purchase rates in the US and UK.<sup>7</sup> Cutler and Zeckhauser (2003), for instance, inferred from a survey of sales clerks in the US that approximately 20% of US washing machine purchasers buy an extended warranty, and the UK's Competition Commission (2003) gave the same estimate for UK consumers. Moreover, various studies including the UK Competition Commission Report (2003) have suggested that extended warranty take-up rates are highest amongst the poor, like those in our Study 1 sample.<sup>8</sup>

<sup>6</sup> Purchase intention cannot be directly inferred from fair price. To see why, imagine we asked people to state the 'fair price' for a wheelchair. We would expect prices in the order of £200 or more, but expect that only those who needed one would be *willing* to pay anything at all.

<sup>7</sup> In our study, of course, we could not emulate the effects of 'hard sell' from zealous salespeople.

<sup>8</sup> Domestic consumer market regulations in Belgium have traditionally worked to insulate consumers from product-related risks and thus evolved very differently from those in the UK and US (Trumbull, 2006). Therefore, the implicit purchase rate of 22% may be on the high side. In Study 2, however, the implicit rate was even higher for the Belgian than London sample.

We next examined the determinants of willingness to buy at the fair price (WTBFP). We estimated two probit regression models, shown in Table 3. The dependent variables were the willingness to buy at least one warranty when offered a choice between all five, and the proportion of the five warranties they would buy. The independent variables were average fair price,  $EBI_1$ , NQS, the price of the selected washing machine, sex and age. Respondents with higher scores on the NQS were less likely to buy a warranty, and those with higher scores on  $EBI_1$  were much more likely to buy one. There was also a small but significant negative relationship between fair price and average WTBFP.

Although the emotional benefits from a warranty did not predict its fair price, they *were* strong predictors of willingness to buy at that price. It appears that respondents distinguish between the price it is reasonable to charge, and what they themselves should do when confronted with that price. This suggests that emotional benefits are key motivators of warranty purchase, even if they do not alter what the consumer thinks it is reasonable to charge.

TABLE 3  
DETERMINANTS OF WILLINGNESS TO BUY AT FAIR PRICE

	Willingness to Buy at least one	Proportion willing to buy
<i>Independent Variables</i>	(1)	(2)
Average Fair Price	-0.003 [0.005]	-0.12 [0.004]***
$EBI_1$	0.866 [0.182]***	0.347 [0.147]**
NQS	-1.049 [0.304]***	-0.717 [0.246]**
Age	0.032 [0.045]	0.012 [0.034]
Sex	1.167 [0.612]*	0.660 [0.511]
Price of the Washing Machine	0.003 [0.004]	-0.001 [0.003]

Constant	-1.126 [1.845]	-1.899 [1.812]
Number of Observations	70	79
R-squared	0.46	0.34

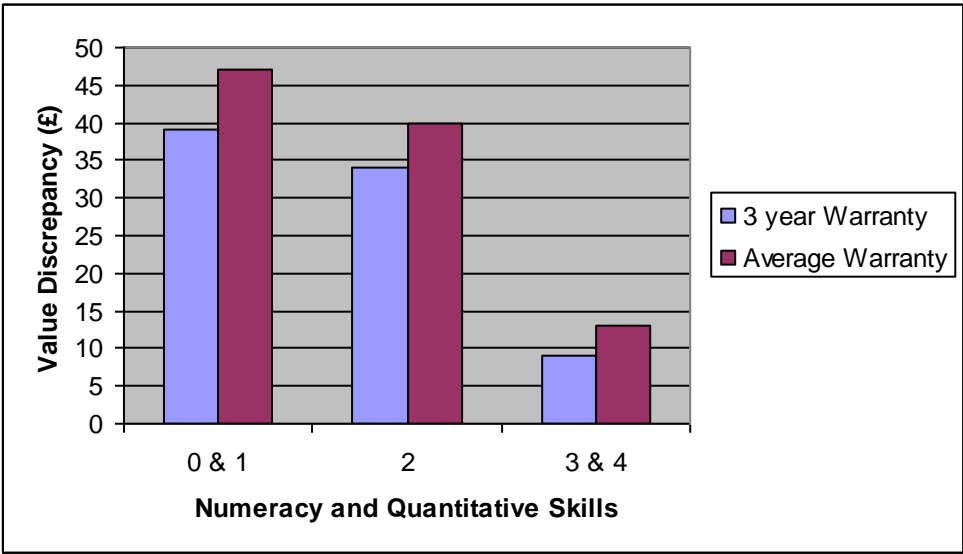
*Notes:* Robust standard errors are reported in brackets. The data are for all survey participants. Deviations from this are accounted for by missing data.  
\* Significant at the 10-percent level; \*\* Significant at the 5-percent level; \*\*\* Significant at the 1-percent level.

### *Numeracy and quantitative skills*

The NQS scale was an important correlate of warranty decisions. Higher NQS scores were associated with lower fair prices as well as less willingness to purchase at those reduced prices. We investigated this relationship by comparing the *value discrepancy*, a term we use to denote the absolute difference between fair price and subjective actuarial value, at different levels of the NQS scale. We divided respondents into three roughly equal-sized groups based on their NQS performance and compared the value discrepancy between groups. As can be seen in Figure 2, those who scored higher on the NQS test showed a lower value discrepancy. A one-way analysis of variance (ANOVA) testing the relationship between NQS and value discrepancy indeed revealed a significant relationship,  $F(4,67) = 2.17$ ,  $p < 0.1$ , and also gave lower estimates of breakdown probability and repair costs. For instance, 66% of those in the top NQS tier (3 or 4 questions correct) overestimated the breakdown likelihood compared to 74% in the other tiers. Similarly, in the top tier 66% overestimated the repair costs compared to nearly 90% in the other two tiers. For those in the top tier, unlike the rest of the sample, breakdown probability was *positively* correlated with fair price. Nonetheless, when it comes to purchasing a warranty, respondents who scored higher on the NQS test were no less influenced by the emotional benefits that having a warranty brings than respondents who scored lower on the NQS test.

FIGURE 2

VALUE DISCREPANCY AS A FUNCTION OF NUMERACY AND COGNITIVE ABILITY



3. STUDY 2: ANTWERP AND LONDON

In Study 2 we focused on the hypotheses that emerged from Study 1, and undertook to replicate them using more refined methods. In addition to subjective actuarial value and fair price, we obtained two further measures of warranty value. These were the maximum willingness to pay for a warranty, and estimated market price. Rather than the 3-item emotional benefits index from Study 1, we developed a more comprehensive and reliable 6-item index. We also simplified our procedure for eliciting expected breakdown probabilities. We carried out our study on a larger and more diverse sample: a group from Belgium drawn from a similar population as that in Study 1, and a group of passers-by in London.

We restricted our new survey instrument to those questions that would allow us to test the main hypotheses we had developed in Study 1. The Belgian sample was a group of unemployed adults who were surveyed while they queued for their monthly benefits at the

*Hulpkas voor Werkloosheidsuitkeringen*<sup>9</sup> in Antwerp. Two research assistants administered the survey following the same protocol as in the first study, except that they also went through the survey with each respondent question by question. The London sample was surveyed at three busy public spaces where a broad cross-section of the London populace is to be found. Random passers-by were invited to fill in the survey, and offered a chocolate bar as a token of our gratitude.

### *A. The Task*

Participants were first asked to imagine they had purchased a washing machine with a recommended retail price of £239.99 and were now considering whether to purchase a 3-year extended warranty for this machine. To make the situation more vivid, we included a colour photo of the washing machine next to this introductory text – this was a real machine widely available at that price. The extended warranty was then introduced and described as follows:

All the questions concern a 3-year Extended Warranty for the washing machine. This warranty increases the manufacturer's warranty from 12 to 36 months. The warranty covers repairs (parts and labour) whenever the machine breaks down.

This procedure was a simplification of that used in Study 1, in which we had asked respondents to choose between machines. We did this in the interest of saving time and removing variance due to differences between machines. The price-point of the single machine corresponded to the average price of the machines chosen in Study 1.

We next elicited four different warranty-related value estimates, which we presented in counterbalanced order, every time with the first question on the first page separated from the

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<sup>9</sup> This is a *Belgian Public Institution for Social Security* that disburses unemployment benefits. There are 34 such offices nationwide, including one in Antwerp.

subsequent three questions on the following page. One value estimate was *subjective actuarial value*. This was elicited with questions about breakdown probability and cost. Firstly, “Out of 100 washing machines like this one, how many do you expect will break down at least once during the extended period (the second or third year after purchase)?”; and next, “Of those, how many will break down two or more times,” and then “three or more times.” This method of eliciting probabilities was a simplification of the one used in Study 1, and allowed us to account for potential multiple expected breakdowns. After giving the probability estimates, respondents answered “If the machine is not under warranty and it breaks down, how much will it cost to repair?”

The remaining cost estimates were fair price, maximum willingness to pay, and market price. The questions were: “What do you think is a fair price for a company to charge for this 3-year Extended Warranty?”, “What would be the maximum price that you personally would be prepared to pay for this 3-year Extended Warranty?” and “Estimate the current market price of this 3-year Extended Warranty.”

We designed a more comprehensive emotional benefits index consisting of six Likert-scale items (we call this EBI<sub>2</sub>). Respondents indicated on a seven-point scale ranging from Strongly agree to Strongly disagree, their degree of agreement with the following six statements about the warranty:

1. It would give me peace of mind.
2. If I didn’t buy it and the washing machine broke down, I would feel a lot of regret.
3. It would be comforting to have the protection of the warranty.
4. Even without the warranty, I would not worry about repair costs.
5. I would feel more under stress without the warranty.
6. Hopefully I won’t need a repair, but I would rather not take the risk.



EBI<sub>2</sub> was the average response to the six statements above on a 7 point scale (with Item 4 negatively coded). Compared to EBI<sub>1</sub>, the EBI<sub>2</sub> incorporates three additional dimensions of warranty-related emotional benefits: regret, stress and risk. The EBI<sub>2</sub> was highly reliable (Cronbach's alpha of 0.84 and a mean inter-item correlation of 0.47) and as in Study 1 the average response to the six statements was slightly above the midpoint of the scale, indicating that the average person believed they got *some* emotional benefits from the warranty.

We concluded the survey with the same four NQS items from Study 1, and questions about the respondent's sex and age.

## *B. Results*

### *Overview*

We replicated the main results of Study 1. First, subjective actuarial value and fair prices were again much higher than their objective counterpart, and this difference decreased with the numeracy and quantitative skills' level of the respondent. Second, judged emotional benefits did not increase fair price estimates, but did increase willingness to buy at that fair price, and maximum willingness to pay. Third, fair prices (and maximum willingness to pay) were influenced by estimates of repair costs but not by breakdown probabilities. We also found that estimated breakdown probabilities *did* have a significant and sizable effect on estimated market prices. This shows that respondents were not unaware or unable to use probability information, but did not perceive it as so important for their own value judgments.

### *Price and value estimates*

Participants generally overestimated the probability a washing machine would break down, overestimated the cost of repair, and, consequently, overestimated the actuarial value. The median breakdown probability for the second and third year after purchase was 21%, compared to the actual likelihood of 12%. The cost of repair was similarly overestimated. In

London the median repair cost was £124 (actual cost would be £75) and in Belgium it was £95 (actual cost would be £60). The median subjective actuarial values were £22 and £16 in London and Belgium, whereas the corresponding actuarial values were £9 and £7.

Fair price estimates were again greater than subjective actuarial values. In addition and as expected, maximum willingness to pay exceeded fair price, and, moreover, the estimated market price was itself well in excess of willingness to pay. Table 4 shows the median price for all value measures for the two samples separately as well as overall, along with the average within-respondent rank of those prices. We evaluated the price measures using Friedman tests for ranks. An overall Friedman test confirmed a strong effect, indicating the ranks differed among themselves,  $\chi^2(3) = 209.8$ ,  $p < 0.001$ . Pair-wise analyses on adjoining pairs revealed that every price was ranked significantly higher than the one below – market price was significantly higher than willingness to pay, which was significantly higher than fair price, and so on. This confirms the finding from Study 1 that fair prices are higher than actuarial value, but adds to it by showing that people are, typically, willing to pay even more than this fair price. It is also interesting to note that market prices were judged to be *much* higher than even the maximum willingness to pay, reflecting the widespread belief that extended warranties are overpriced. Indeed, this belief is justified. For instance, the actual price of a 3-year extended warranty for the washing machine in our study is £82.99 in the UK's largest retailer (Argos) – roughly four times the median subjective actuarial value, and *twelve* times the objective value.

TABLE 4  
MEDIAN WARRANTY VALUE ESTIMATES

<i>London Sample Only</i>				
	Market Price	WTP	Fair Price	Actuarial Value
Market Price First	<b>69</b>	69.99	50	25.5
WTP First	80	<b>50</b>	50	12.8
Fair Price First	64.99	50	<b>50</b>	17.6
Actuarial Value First	80	50	50	<b>36</b>

<i>Antwerp Sample Only</i>				
Market Price First	<b>67.2</b>	33.97	30.57	22.75
WTP First	33.9	<b>33.97</b>	30.57	14.7
Fair Price First	52.6	20.65	<b>33.97</b>	10.87
Actuarial Value First	57.7	33.97	33.97	<b>14.7</b>
<i>Overall</i>				
Median Value	67.94	46.28	40.00	19.26
Mean Rank	3.49	2.50	2.19	1.83

As in Study 1, we investigated the determinants of fair price, market price and WTP by estimating an OLS regression model with each value measure regressed onto probability of breakdown, estimated repair cost, the emotional benefits index ( $EBI_2$ ), numeracy and quantitative skills (NQS), a dummy variable for the sample location (Belgium or UK), along with age and sex. Table 5 presents the regression results. It shows that repair costs significantly predict all three price measures. As in Study 1, breakdown probability did not significantly predict fair price, nor did it predict the new measure of maximum willingness to pay. It was, however, a significant predictor of market price. This shows that the respondents knew the link between breakdown probability and price, but nonetheless did not consider it to be important when deciding how much they themselves would pay.

Further, perceived emotional benefits, measured by  $EBI_2$  significantly predicted maximum willingness to pay but not judged fair price. This corresponds to what we found in Study 1, where  $EBI_1$  predicted willingness to buy at a fair price, but not the fair price itself.

Although none of the coefficients on NQS were statistically significant in this analysis, the results are nonetheless consistent with our earlier finding in that those with higher numeracy and quantitative skills tend to give lower price estimates. As we might expect if a high NQS score significantly and positively correlates with a personal view that extended warranties are poor value for money, this was particularly true for judged fair price and WTP but not for market price.

Finally, older people tended *ceteris paribus* to give lower fair price and maximum price estimates. For each additional year of age, these estimates were approximately £0.60 lower. The magnitude of this effect is the same as in Study 1, although the larger sample size of Study 2 renders it significant. This lends further support to the view that more experienced consumers are in general less likely to suffer from judgmental biases that lead people to widely overstate fair price (e.g., Kovalchik et al., 2005).

TABLE 5  
DETERMINANTS OF WARRANTY VALUE ESTIMATES

	Fair Price for a 3-Year Warranty		Maximum Price for a 3-Year Warranty		Market Price for a 3-Year Warranty	
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Repair Costs	0.082 [0.044]*	0.073 [0.044]*	0.111 [0.041]**	0.203 [0.047]**	0.254 [0.072]***	0.247 [0.073]***
Breakdown Probability	18.41 [9.75]	12.923 [9.46]	30.44 [19.865]	27.055 [18.624]	50.809 [16.959]***	47.16 [19.015]**
EBI <sub>2</sub>	3.571 [1.993]	2.867 [2.113]	8.805 [2.516]***	7.783 [2.717]***	2.947 [2.654]	1.783 [2.692]
NQS	-1.363 [2.667]	-1.845 [2.691]	-1.032 [3.177]	-0.9 [3.074]	-0.356 [4.879]	-0.219 [5.016]
Age		-0.682 [0.245]***		-0.576 [0.275]**		-0.75 [0.454]
Sex		9.142 [6.098]		9.78 [6.246]		12.395 [9.121]
Antwerp Dummy	-20.06 [6.163]**	-15.923 [5.227]***	-20.865 [7.345]***	-17.021 [9.379]***	-26.811 [8.09]***	-23.004 [8.361]***
Constant	26.351 [12.194]**	51.594 [16.151]***	1.464 [14.784]*	21.556 [20.298]		52.704 [30.559]*
Number of Observations	205	205	205	205	205	205
R-squared	0.12	0.14	0.16	0.12	0.23	0.24

Notes: Robust standard errors are reported in brackets. *Average fair price* is the average fair price value of one year, two years, three and four years of extended coverage. The data are for all survey participants. Deviations from this are accounted for by missing data.

\* Significant at the 10-percent level; \*\* Significant at the 5-percent level; \*\*\* Significant at the 1-percent level.

*Willingness to buy a warranty*

Study 2 revealed, as did Study 1, that a large proportion of people are willing to buy an extended warranty at a greatly inflated price. Despite the very high fair price estimates relative to actuarial value, 75% of respondents indicated they would buy a warranty at this price. This is not just because people anchored their fair price estimates on repair costs or willingness to pay: the analysis is unchanged if it is restricted to those participants who answered the “fair price” question first. Of course, the fair price estimate was lower than the actual market price, so we computed how many gave a maximum price greater than the market price in their country – 22% in the UK (where the market price is £83) and 37% in Belgium (where the market price is £40).

The evidence in Study 1 suggested that concerns about emotional gains play a significant role in decision-making over warranty purchases. We tested whether variations in EBI predicted warranty purchase by estimating a simple probit regression model. A binary variable corresponding to the respondent’s willingness to buy the warranty at its fair price (WTBFP) was regressed onto fair price, the emotional benefits index ( $EBI_2$ ), and a number of control variables. Table 6 summarizes the results. We find that  $EBI_2$  significantly predicts WTBFP. The estimated coefficient of  $EBI_2$  (column (2) of Table 6) shows that a 1 point increase (on a scale from 1 to 7) in the average response to the six emotional benefits questions raises WTBFP by over 20 percentage points. The effect is of approximately the same magnitude as in Study 1.

The only other statistically significant predictors of WTBFP were fair price and location (Antwerp versus London). Purchase likelihood was lower for higher fair prices. More interestingly, London respondents were more likely to buy at the fair price than were those in Antwerp, again consistent with the distinct consumer cultures and regulation experiences in Belgium and the UK. Notably, all of these results hold when we limit ourselves to only those

respondents who were asked first, and therefore answered free of any possible influence from later items, about fair price and willingness to buy at that fair price (see columns (3) and (4)).

TABLE 6  
DETERMINANTS OF WILLINGNESS TO BUY AT FAIR PRICE

<i>Independent Variables</i>	Willingness to Buy			
	Overall		Respondents with Fair Price and WTBF questions first only	
	(1)	(2)	(3)	(4)
Fair Price	-0.005 [0.002]**	-0.005 [0.002]**	-0.005 [0.003]*	-0.005 [0.003]*
EBI <sub>2</sub>	0.232 [0.080]***	0.237 [0.077]***	0.291 [0.144]**	0.406 [0.185]**
NQS	0.197 [0.120]*	0.185 [0.121]	0.097 [0.244]	0.125 [0.241]*
Age		-0.002 [0.01]		-0.027 [0.018]
Sex		0.161 [0.214]		0.084 [0.43]
Antwerp Dummy	-0.044 [0.224]	-0.079 [0.219]	-1.081 [0.442]**	-1.485 [0.489]*
Constant	-0.355 [0.64]	-0.34 [0.483]	-0.153 [0.97]	-0.153 [1.441]
Number of Observations	205	205	49	49
R-squared	0.07	0.08	0.18	0.21

*Notes:* Robust standard errors are reported in brackets. *Average fair price* is the average fair price value of one year, two years, three and four years of extended coverage. The Data Appendix describes the construction of the variables. The data are for all survey participants. Deviations from this are accounted for by missing data.

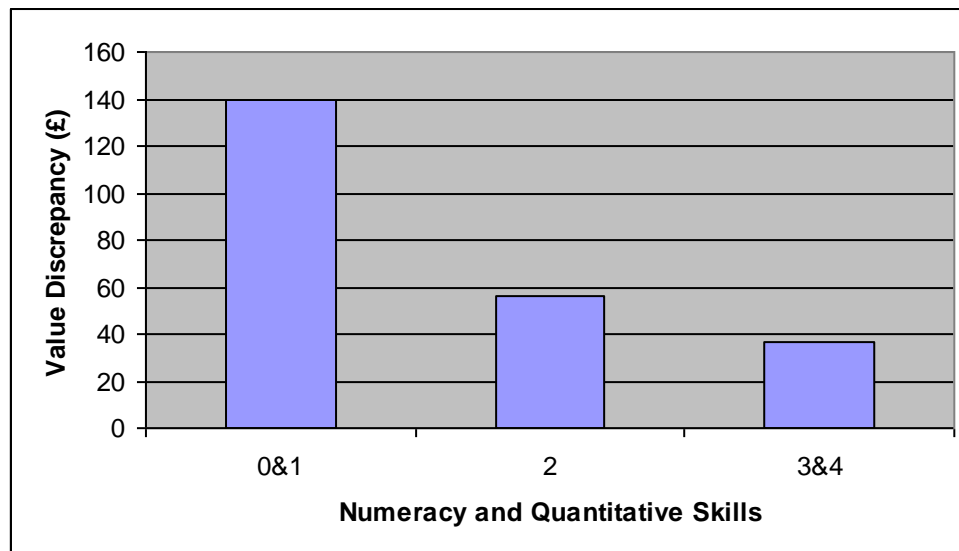
\* Significant at the 10-percent level; \*\* Significant at the 5-percent level;

\*\*\* Significant at the 1-percent level.

### *Numeracy and quantitative skills*

The value discrepancy (or absolute difference between fair price and subjective actuarial value) was, again, negatively correlated with numeracy and quantitative skills. This is shown in Figure 3, which plots mean value discrepancy as a function of NQS performance. We tested this relationship with a one-way analysis of variance (ANOVA) with value discrepancy as the dependent variable and NQS as the independent variable. The ANOVA was significant,  $F(2,202) = 4.01$ ,  $p < 0.02$ ,  $\varepsilon^2 = 0.035$ , and post-hoc (Tukey) tests revealed that the value discrepancy of both the '2' and '3&4' groups were significantly lower than the value discrepancy in the '0&1' group. Again consistent with Study 1, higher NQS were associated with lower expected repair costs and estimated breakdown probabilities. And, for the top NQS group only, we find that both repair costs and breakdown probability were more strongly and positively correlated with fair price. Nonetheless, the warranty purchase decision by respondents with high scores on the NQS test was still most importantly influenced by emotional considerations, and not at all by the expected breakdown probability.<sup>10</sup>

FIGURE 3  
VALUE DISCREPANCY AND FINANCIAL LITERACY AND COGNITIVE ABILITY



<sup>10</sup> We split our sample into two groups based on individuals' NQS test score and repeated the same analysis as in Table 3 for each group. The estimated OLS coefficients reveal the same insights as those reported in Table 3. We therefore conclude that individuals with a higher NQS test score are no less influenced by the emotional benefits when deciding whether to buy a warranty.

#### 4. DISCUSSION OF EMPIRICAL RESULTS

Our study involved hypothetical questions and this may have distorted our findings. First, respondents may have overstated the value they placed on warranties to please us, while others may have understated it to show their financial sophistication. Moreover, factors that enter into actual warranty decision making, such as being in a “hot state” following pressure from salespeople, were absent in our study. Nonetheless, we have reason to think our data do reflect many of the determinants of true warranty decision making. First, the overall pattern or ranking of warranty values was consistent across two quite different studies, and, second, the percentage of people willing to buy at the existing market price was close to the proportion that actually does make such purchases. In this section we reflect further on the results and implications of our investigation.

The conventional economic approach holds that the main determinant of a consumer’s decision of whether to buy a warranty will be its actuarial value. This conclusion follows from three assumptions: (i) consumers have roughly accurate perceptions of actuarial value; (ii) they are approximately risk-neutral for small-scale insurance products (because individual product breakdown risks are small and diversifiable); and (iii) they are willing to pay an amount that is close to and determined by their (approximately accurate) subjective actuarial value. The conclusion and its underlying assumptions were not supported by our data.

Assumption (i) is at variance with the finding that subjective actuarial values, based on our respondents’ estimates of breakdown probability and repair costs, were roughly three times the corresponding objective values. Moreover, even these inflated subjective values played a surprisingly small role in warranty valuation: contradicting Assumption (ii) and casting doubt on (iii), two measures of subjective value (fair price and maximum willingness to pay for a warranty) were significantly higher than the corresponding subjective actuarial values.



Casting further doubt on Assumption (iii), the two value measures were very weakly correlated with subjective actuarial value and further analysis showed that while estimates of repair costs did significantly predict value, estimated breakdown probability did not. In Study 1, indeed, the correlation between probability and fair price was (non-significantly) *negative*.

The low correlation between estimated breakdown probability and several measures of warranty value departs from normative expectations, as well as two frequently cited explanations for why people buy small-scale insurance. The first of these is that the probability of rare events is overestimated (e.g., Johnson et al., 1993). This explanation was given by Eisner and Strotz (1962), for instance, as an explanation for the purchase of flight insurance, who attributed the overestimation to the “plentiful publicity of plane crashes.” Eisner and Strotz’s suggestion was taken up by Lichtenstein et al. (1978) who showed the close relationship between judged risk and publicity. The second explanation is that insurance is purchased because people *overweight*, as well as overestimate, small probabilities. This overweighting is a core prediction of prospect theory and one that has stood the test of time. Kahneman and Tversky (1979) themselves suggested that this could explain why people buy insurance.<sup>11</sup> However, while these two explanations can predict why people might overpay for insurance, they both predict that subjective probability and subjective value will be correlated. Consequently, they cannot be the whole story.

An additional hypothesis, again coming from prospect theory (Kahneman and Tversky, 1979) is that the subjective probabilities observed in our study are in an intermediate range over which people are relatively insensitive. Kahneman and Tversky, for instance, suggested the Allais paradox occurred because while people saw a big difference between a probability of

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<sup>11</sup> It is perhaps unnecessary to emphasize that Kahneman and Tversky (1979) took a more sophisticated view of matters. As they observe “A comprehensive theory of insurance behaviour should consider, in addition to pure attitudes toward uncertainty and money, such factors as the value of security [what we would call peace of mind], social norms of prudence, the aversiveness of a large number of small payments spread over time, information and misinformation regarding probabilities and outcomes, and many others.” (p. 286)

99% and 100%, they saw little difference between 10% and 11%. Such a direct application of prospect theory will not, however, hold for our data. First, subjective breakdown probabilities estimates were *not* restricted to a narrow range; the estimated likelihood that a machine would break down at least once varied from 0 to .9, with much dispersion within that range<sup>12</sup>. No theory predicts complete insensitivity within such a range. Second, the probability estimates did significantly predict estimates of *market* price. This shows that our respondents were aware of the relevance of probability to those selling the warranty, but did not judge it as relevant to their own decisions about whether to buy the warranty or how much to pay.

Our findings appear to be an example of *probability neglect*, in which warranty purchase decision depends on the magnitude of the possible consequences of not having insurance, and not on the probability of having to suffer those consequences. Probability neglect is a familiar result in the study of risk perception for highly emotive risks such as the loss of a child, a terrorist attack, or being trapped in a car underwater while wearing a seat belt (Baron, Hershey and Kunreuther, 2000; Rottenstreich and Hsee, 2001; Sunstein, 2003). Some researchers have also found probability neglect for insurance evaluation, although usually when all probabilities are very low. Kunreuther, Novemsky and Kahneman (2001), for instance, found that that mean willingness to pay for insurance varied little when the probabilities ranged from 1 in 100,000 to 1 in 10 million, and for ranges from 1 in 650 to 1 in 68,000. Likewise, Hogarth and Kunreuther (1995) found that people choosing to purchase an extended warranty typically did not state that the probability of needing a repair as a reason for purchase.

In contrast to probability, the *consequences* of not having insurance did play a role in decision making. These consequences take two forms: The potential cost if a machine breaks down,

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<sup>12</sup> As further evidence that probability was not seen to be relevant to warranty pricing, those who gave breakdown probabilities of 0 typically gave positive values for warranty fair price and maximum willingness to pay.

and the emotional benefits of having insurance, especially the ubiquitous concept of “peace of mind.” Although both influenced insurance pricing, emotional benefits appeared to play the greater role.<sup>13</sup> Perhaps we should not be surprised by this, since peace of mind will be an ongoing experience, while the economic benefits will occur only once, if at all. Just like a tightrope walker who will benefit from the continuous feeling of security provided by a safety net even if he never has to use it, so will someone who is insured feel (or, at least, at the moment of purchase, *expect* to feel) continuous peace of mind even if there is never any need to draw on the insurance.

Our survey data also allowed us to examine *who* is most susceptible to the biases of (i) misjudging breakdown probabilities, (ii) overestimating repair costs, (iii) stating a WTP that does not relate to both these factors, and (iv) stating a WTP that greatly exceeds subjective actuarial value. We found that all of these biases were lower for those with greater numeracy and cognitive skills. People with higher scores on our NQS test consistently gave fair price estimates that lie closer to subjective actuarial value, and estimates of breakdown probability and risk that lie closer to their actual values. A comparison between the true standard market price of a warranty and individuals’ direct measure of warranty value shows that people with higher NQS were relatively much less likely to buy at standard market price. This result adds to a growing body of work showing the importance of general and specific cognitive skills for decision-making (e.g., Stanovich and West, 1998; Frederick, 2005; Benjamin, Brown and Shapiro, 2006; Peters et al., 2006), and financial decision-making in particular (e.g., Cawley, Heckman and Vytlačil, 2001; Lusardi and Mitchell, 2007a and 2007b, Fang et al., 2007).

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<sup>13</sup> The standardized regression coefficient for EBI, when predicting both fair price and WTP, was greater than that for repair cost. This was true despite the fact that the repair cost was given in the same currency as the value estimate, and always appeared closer in the questionnaire, so any “common method variance” effect would favour repair cost.

## 5. CONCLUDING REMARKS

Roughly one out of three consumers of washing machines purchases a warranty. Despite this high take-up rate, there have been relatively few efforts to dig into this phenomenon and show what consumers value about warranties. This paper has shown that warranty purchase cannot be solely attributed to a tendency to overestimate the cost and likelihood of product breakdown – in fact, our results show evidence of probability neglect. Rather, the emotional benefit, which consumers expect to gain from having a warranty, turns out to be the best predictor of their purchase decisions. Interestingly, while consumers with a higher score on the NQS test were significantly less susceptible to biases in their warranty value estimations, they were no less influenced by these emotional benefits when deciding whether to purchase a warranty.

The results presented here contribute to debates about whether and, if so, how government should protect consumer welfare in the market for warranties. Observe that in theory, there is no a priori rationale for any consumer protection measures: extended warranties should be a good deal for all parties involved. In particular, their advantage is not merely that they allow the pooling of risk, but also that the providers can achieve economies of scale. A warranty provider specializing in electrical goods can deliver services at a much lower rate than a consumer could buy those services at retail and, moreover, can act as an information conduit and so eliminate the need for shopping around and obtaining quotes. Nonetheless, despite these potential social benefits from extended warranties, there is ample evidence that warranty providers get the lion's share of these benefits.

In our own study, we found that the *maximum* willingness to pay of our respondents is not very far below the market price. This suggests that warranty sellers are extracting close to the maximum consumer surplus from their clients. Adding to this, it has frequently been suggested that it is only through the sales of warranties that electronic retailers can survive.

Warranty Week (2005) reported that although extended warranties are usually only between 3% and 4% of sales, they can bring 30% to 40% of profits. This means that high warranty prices are cross-subsidizing the low prices on electronics (see e.g., Gabaix and Laibson, 2006). Given our finding that willingness to pay for warranties is greatest for those scoring low on the NQS test, and other research suggesting that poor people are most likely to buy extended warranties, this suggests that high warranty prices may produce a situation in which the least well off who buy warranties are enabling the better off who do not buy warranties to get a better deal on their electronics.

One potential solution to the problem -- one that our colleagues in the regulatory world frequently suggest-- is to give consumers “more information.” Most frequently, it is proposed that, at the point of sale, those about to buy a washing machine are informed about such quantitative risk factors as breakdown probability and repair costs. There are three reasons why we do not think this solution will work. Firstly, and as shown by our research, even when people know the economic risk factors, they give them surprisingly little weight in their judgments of warranty value. This suggests that even if they are reminded about them they may not use their knowledge optimally (if at all). A second reason is that economic risk factors are not the only reasons people want insurance. In our study, emotional benefits were bigger predictors of willingness to buy than the objective risk factors. If retailers highlight economic risk factors, there is a possibility that, at the point of sale, we will deflect people’s attention away from what really matters to them. Those who might really benefit from peace of mind might not buy a warranty because of the information they are given. The third reason is a familiar one. While quantitative risk factors can be measured post-hoc, problems of moral hazard and adverse selection make them difficult to assess a-priori, since they will be a function of the information provided. Suppose, for instance, the retailer was required to tell everyone that the probability of machine breakdown was 15%. Then, if people are rational, and holding other factors constant, only those who expect the probability of breakdown to be greater than 15% would buy insurance. Therefore, the actual probability the retailer will face

will be higher than the one they report, and it would be unacceptable to demand that the retailer provide such a number – but then which number should they provide? This is a basic extension of the lemons problem (Akerlof, 1970). Thus, it is not at all certain that requiring retailers to provide information about economic risks is either feasible or desirable.

More importantly, however, we suggest that the warranty problem, and the solution to that problem, is a simple one. It is, in fact, the most fundamental problem and solution in economics: the problem is a market failure, and the solution is to improve the market.

Intuitively, consumers pay too much for warranties simply because they cost too much. They cost too much because retailers typically have effective monopoly power at the point of sale since they either supply warranties themselves, or else ally themselves with a single provider (e.g., Warranty Week, 2006). This is, indeed, essentially the claim made by the Competition Commission (2005), who found that prices of extended warranties tended to be determined by what the consumer would bear rather than variations in economic costs or risks, and that warranty retailers charge more and make more profits than they would in a truly competitive environment. Thus, giving information to consumers may change the demand curve for warranties, but it will not change this monopolistic supply curve. This can only be done by ensuring there is a market for warranties at the point of sale.

The central feature of a functioning market is that because providers compete for the business of customers, prices are pushed downward, and consumers can get the best deal without the minimum cognitive effort – they do not have to combine breakdown probabilities and repair costs because warranty sellers have done it for them. To a first approximation, all consumers have to do is choose or reject the best deal amongst those available. If a consumer believes that a warranty is worth three times its objective value, but finds that she can buy it for one third of that price, she will buy it and obtain benefits from knowing she has obtained a bargain as well as the warranty itself.

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